CEAL - 0522
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14 January 1959

MEMORANDUM FOR: Deputy Director (Plans)

SUBJECT : Grunger Countermeasures Repeater, Mod 504

REFERENCES : A. CEAL-0507 dated 2 January 1959
B. CEAL-0502 dated 6 January 1959
C. CEAL-0486 dated 30 December 1958

1. This memorandum is submitted as a timely summation of the Grunger Countermeasures Repeater program. The conclusions and recommendations are necessarily tentative pending the results of the flight test program now in progress.

2. Analysis of the available flight test data shows that the present configuration of the Mod 504 does not cause complete "break-lock" under all flight conditions. On occasion, the Repeater has caused the AI radar to break-lock at which time the system becomes passive thus allowing the attacking pilot to re-establish a lock-on condition. Depending upon the ability of the pilot to obtain a new lock-on, the characteristics of the radar set is automatically returning to "search" after loss of lock-on or a manual transition period, and the rate of closure of the attacker, the sequence of "search-lock-break lock-search" is repeated during the tactical intercept. Under test conditions this sequence has been repeated about once per mile of closure. The Mod 504 protection at a range of 3 to 4 miles is not conclusive. The ability of the Mod 504 to effect jamming at ranges less than three miles is nil. The most effective range is 5 to 10 miles. The fact that the Grunger box does not always cause a complete break-lock is not necessarily a tactical determent of the system. Since the attacking pilot can return to "search" and re-orient the target, continuous false information may be better protection than intermittent false and true pictures. The recent modification providing for the Mod 504 to remain active for a short time period after the break lock indicates that the difficulty of obtaining a subsequent lock-on is magnified.

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3. The recently conducted "Zoom Climb" tests indicate that an aircraft with the performance capabilities of the F-104 should begin the pull-up for interception at a range of 18 miles. Due to the lack of maneuverability of such an airplane at high altitude, the flight path must be established prior to reaching 60,000 feet. Only small corrections are possible past this point of the intercept. During such an attack the interceptor will reach 60,000 feet at a slant range of 7.36 miles and a climb angle of 8.8°. This range and angle is almost optimum for the utilization of the installed Orangor box. An aircraft with capabilities of the F-102 will initiate its attack at a slant range of 7 miles and reach the firing point at a slant range of 7.49 miles, 0.6 minutes later. The "look" angle of the radar at the time of firing would be 18°. This angle is only 8° off maximum signal strength of the Mod 504 and the slant ranges of both the points of pull-up and firing are in the region of best effectiveness of the jammer. (Typical attack profiles are attached to this summary.)

4. All of the flight testing to date has been performed with the attacking aircraft at the same altitude as the target. In this attitude the target presents minimum radar reflectivity and enhances the capability of Orangor system. As the "look" angle of the radar is increased, it is reasonable to expect some loss in performance of the Mod 504. The results of the "Zoom Climb" tests indicate that the "look" angle is not as great as was previously supposed. Tests are now under way (to be started 15 January 1959) using F-102, F-104 and F-106 attacker aircraft to give a true perspective to the operational mission intercept and the countermeasures capability. More definite conclusions can be reached after these test flights are completed.

5. In the present development program the intangible area is that of technical improvement of the system. It has not been resolved, however, that technical improvement is required. The flight tests to date indicate that the system is performing the design requirements in such a manner as to prevent the successful intercept by an interceptor aircraft equipped with a conical scan radar and beam riding missile. It must be remembered that the complete test program has not been accomplished. If the final testing points to a need for technical improvement the most often proffered suggestion is that of increasing the output power of the Repeater. Before pursuing such an approach, careful consideration must be given to the cost in terms of time, effort, probability of success, system reliability, and, of course, money. In reference A, [redacted] states that the results to be expected from a 50 watt tube would

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not justify the time and effort. He is not sure that the 1,000 watt tube would do the job, but suggests a course of action on the 50 watt system. Such reasoning is not consistent. The time period to develope the 50 watt package is in the order of a year to a year and a half. Such a time period is not in agreement with the operational needs nor the operational life expectancy of the present aircraft. The opinion of [redacted] that the larger tube will have less reliability than the small tube is a serious threat to mission accomplishment.

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6. There are many conclusions to be reached from the foregoing summation. The most important ones are:

a. The Grumman Mod 50A in its present configuration is accomplishing the intent of the design. The overall capability cannot be assessed until the flight test program is complete.

b. Although various proposals have been suggested for product improvement, there has not been established a need for such action.

c. If product improvement is required, the most promising course of action is to increase the output power. The magnitude desired is not determined.

d. The results to be expected from a 50 watt tube would not justify the time and effort.

e. The minimum time to develope any new system is six to nine months. Such a delay would negate the systems use in the operational vehicle.

f. The reliability of the proposed larger tubes is less than the present 1 watt tube.

7. Based on the above conclusions, the following recommendations are submitted:

a. The flight test program of the present configuration should be completed as soon as possible, consistent with good flight test techniques (this is being accomplished).

b. The more leisurely development of a more powerful system should not be initiated nor pursued at the present time.

c. If the present flight test results are as favorable as those against the F-5E aircraft, the Granger Mod 50A should be released from R & D and given to CHALICE Operations for operational employment.

/s/

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CONCUR:

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/s/

D & P, DPD-HQ/F

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(Operations

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RDH:eml (14 Jun 1959)

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